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Hybrid Silicon Laser Interesting Facts

Hybrid Silicon Laser – Interesting Facts

- Silicon is an inefficient light emitter because of a fundamental limitation called an indirect bandgap. An indirect bandgap prevents the atoms in silicon from emitting photons in large numbers when an electrical charge is applied. Instead, silicon emits heat. Researchers at Intel & UCSB bonded Indium Phosphide to silicon to create a Hybrid silicon laser, which will bypass this limitation.

- Indium Phosphide is one of a few special materials, including Gallium Arsenide, which emits energy as a photon of light when voltage is applied. Both materials are used today to make laser diodes, and are referred to as 'III-V materials' on the Periodic Table of elements because they share similar characteristics.

- The researchers at Intel and UCSB combined the light emitting benefits of Indium Phosphide with the low cost benefits of silicon to make the first electrically pumped hybrid silicon laser.

- Each hybrid silicon laser built by Intel and UCSB measures about 1 micron wide and about 800 microns long. By comparison, an average human hair is about 100 microns thick. About 100 of these hybrid lasers could fit in an area the size of the fingernail on your small finger.

- A major benefit of using silicon in the hybrid laser is the ability to integrate multiple lasers and other electronic components together. For example, one could integrate 25 hybrid lasers and 25 silicon modulators operating at 40Gb/s onto a single chip to create an optical link that operates at one terabit per second.

- Optical fibers provide a lot of room for communication technology growth. The theoretical maximum data rate that a single fiber can carry is over 10 trillion bits per second. This is enough capacity to carry phone calls from everyone on Earth simultaneously.

- Typical communications lasers use Indium Phosphide or Gallium Arsenide. However, they require very precise manufacturing and assembly, which can account for 30 to 50% percent of the final price of some optical products. The UCSB / Intel Hybrid silicon laser uses a unique bonding technique to simplify manufacturing, making it easier to build these devices in volume at lower cost.

- The Hybrid silicon laser that Intel and UCSB constructed uses oxygen plasma to form a layer of oxide onto the Indium Phosphide and the silicon. This oxide, which acts like "glass-glue", is as thin as 50 Angstroms thick (roughly 25 atoms). An Angstrom is equal to one hundred-millionth of a centimeter. By comparison, a sheet of paper is about one million Angstroms thick.

- Optical fibers can carry multiple simultaneous data channels by using different colors of light. This is like having multiple radio stations transmitted to your car radio. However, since the wavelength of the light is millions of times smaller than the wavelength of the radio waves used by your radio the optical fiber can carry millions of times more data.

- Although silicon appears opaque to the naked eye, it is actually transparent to infrared light. If you had infrared vision you could see through silicon, just as Superman can see through walls with X-ray vision. This infrared transparency property makes it possible to route light in silicon.

- Silicon Photonics is the technology of making optical devices using silicon and standard CMOS manufacturing techniques. By "siliconizing" Photonics, Intel intends to use its silicon technology and high-volume manufacturing capabilities to benefit optical communications. These silicon photonic devices may someday be used to build high-speed busses and other interconnects in PCs and Servers as well as connections between PCs, servers and other devices.

- A photon is the most basic element of light, just as an electron is the most basic element of electricity. Photonics refers to the study of photons, especially the use of light for communicating information. Silicon Photonics is the study of making these optical communications devices out of silicon.

- Intel' has had several silicon photonic breakthroughs including: the first raman silicon laser, the first 1GHz silicon modulator, then a 10Gb/s modulator and world-class performance in SiGe based photo-detectors.

- UCSB is a leader in photonic integrated circuits and bonding technology and has demonstrated several breakthroughs, including high temperature vertical cavity lasers, high-speed lasers and photodetectors.